Navigation R&D Portfolio and Data Integration Framework

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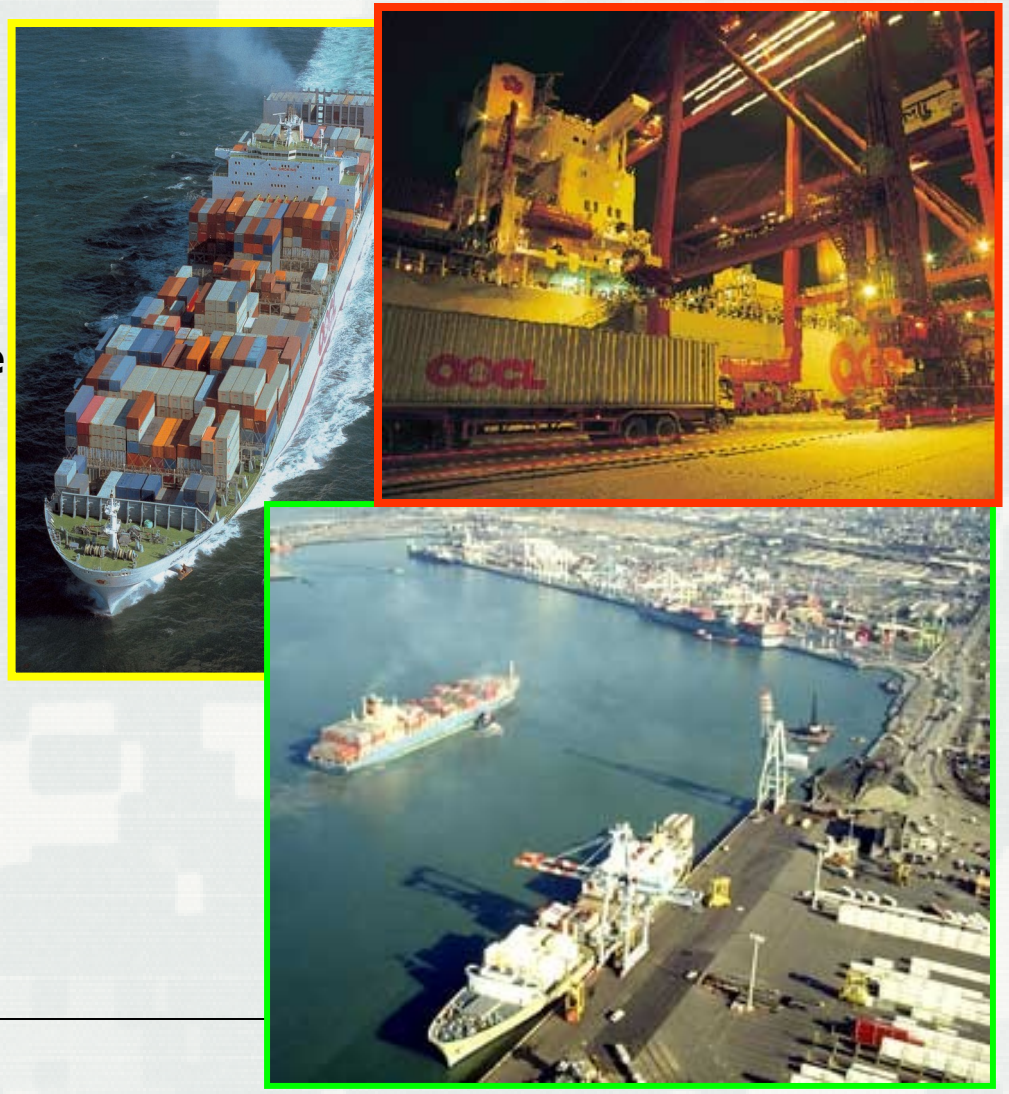
Engineering Research and Development Center
U.S. Army Corps of Engineers

Mobile, AL
16 March 2010

US Army Corps of Engineers
BUILDING STRONG®

Marine Transportation System

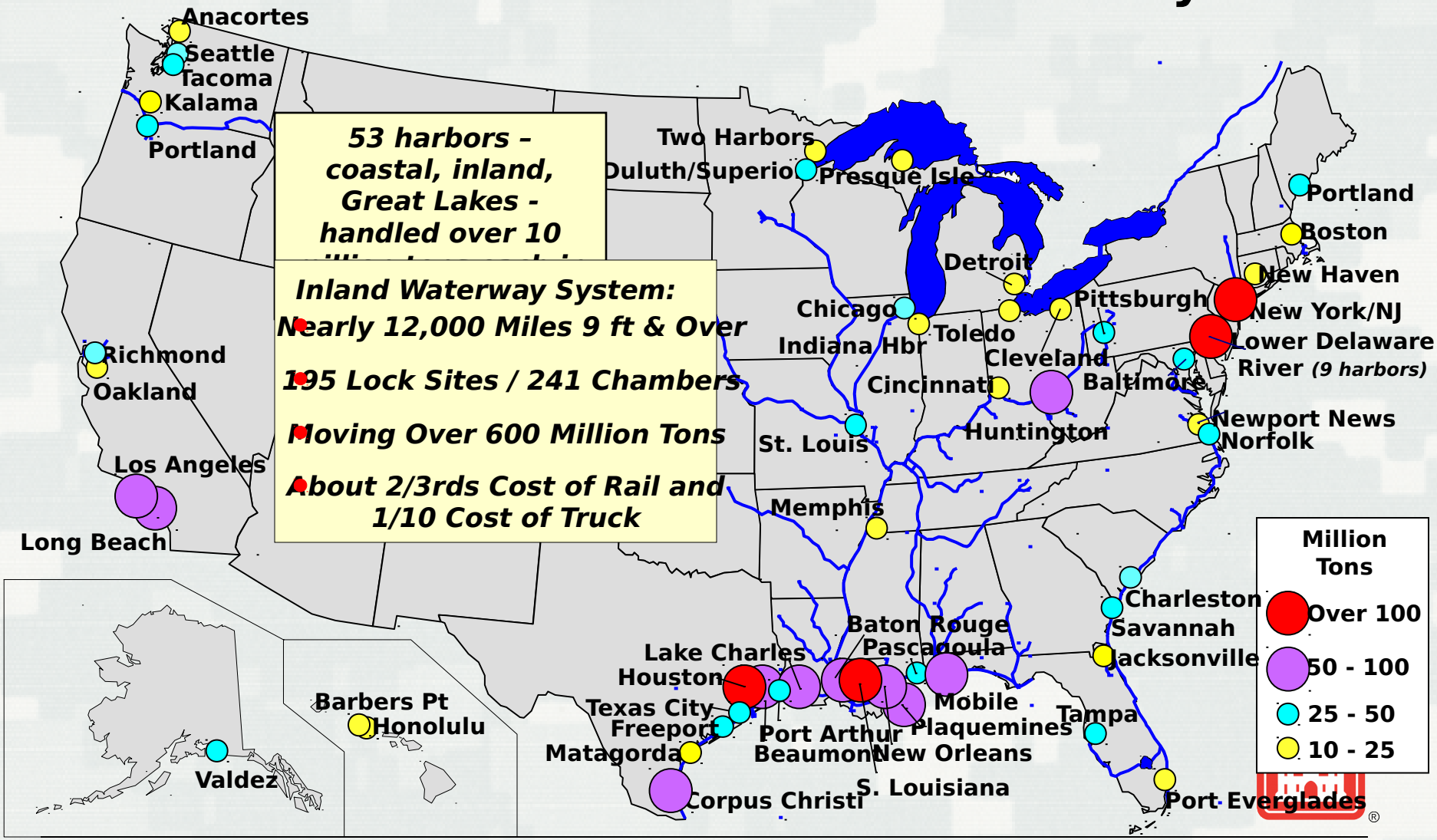
- **Value of all foreign trade represents nearly 30% of nation's GDP *(vs 13% in 1970)***
- **Overseas waterborne trade**
  - **95% of overseas trade by volume**
  - **75% of overseas trade by value**
  - **8.4 million jobs**
- **About $2 trillion in economic activity**
- **System nearing capacity**
- **Cargo volumes projected to increase by 50% - containers to double by 2020**
- **Already a generation behind in channel improvements – but West Coast in better shape**
- **Capacity constraints increase transportation costs, pollution, congestion**



Corps Navigation Mission

Provide safe, reliable, efficient, effective and environmentally sustainable waterborne transportation systems for movement of commerce, national security needs, and recreation.

U.S. Ports: Vital to Trade
…and to Our National Economy



BUILDING STRONG®

Navigation R&D Programs

Dredging Operations and Environmental Research

Coastal Inlets Research Program

Navigation Systems

Regional Sediment Management Demo

Monitoring Completed Navigation Projects

Dredging Operations Technical Support

Inland Electronic Navigation Charts

Coastal Zone Mapping and Imaging

ARRA Improving Throughput & Safe

Inland Navigation Safety Initiative

Navigation Structures

Dredging Operations and Environmental Research (DOER)

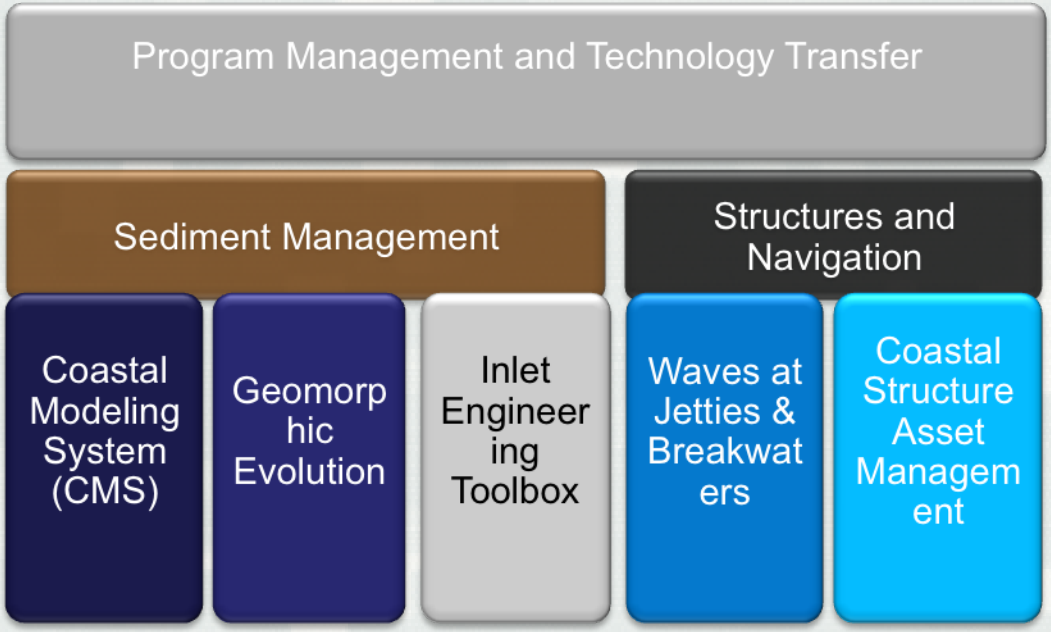
- Resolve complex engineering, economic, and environmental challenges through advancing the science and engineering applied to navigation dredging operations.
- Results will provide dredging project managers with technology for cost effective operation, evaluation of risks associated with management alternatives, and environmental compliance.

PM: Dr. Todd Bridges
APM: Eddie Wiggins

Coastal Inlets Research Program

Advance inlet science and engineering to reduce O&M at coastal inlet navigation channels, structures, and adjacent beaches

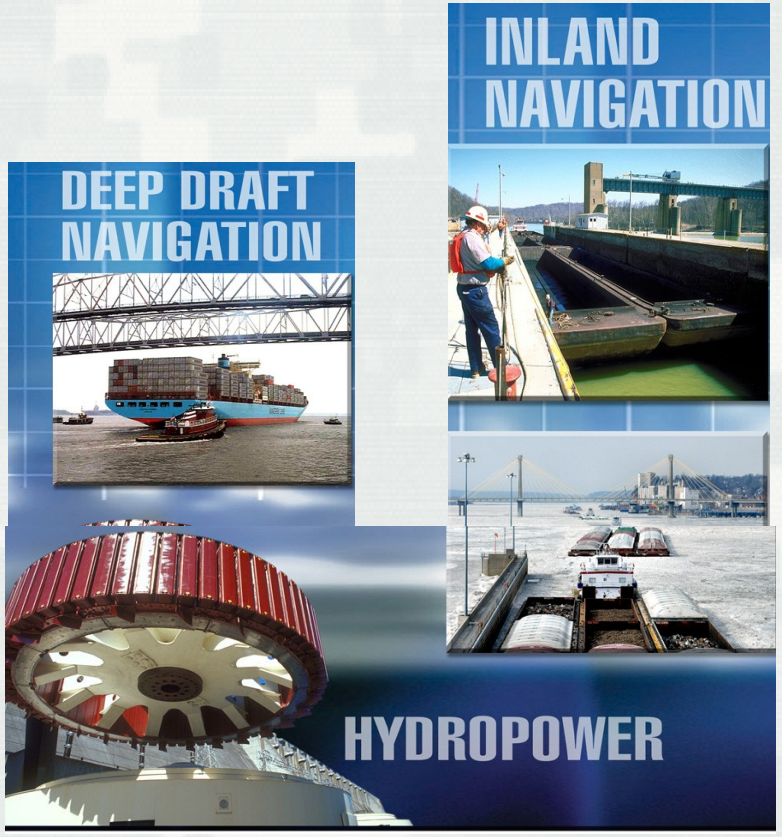
- Integrated modeling system for desk-top calculations to rapidly evaluate O&M alternatives
- Guidance and methodology to incorporate economic benefits of navigation channels within the design and management of coastal navigation projects
- Transfer technology to District and Division personnel



PM: Dr. Julie Rosati
APM: Dr. Nick Kraus

Navigation Systems Research Program

Meet marine transportation, hydropower and infrastructure challenges through research that incorporates engineering, economic, and environmental solutions.



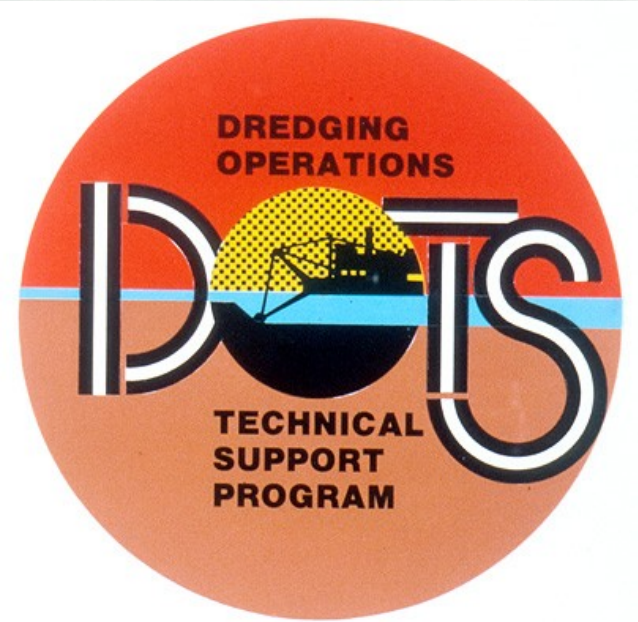
PRODUCTS SUPPORT

- **Business line performance measures**
- **Environmental compliance requirements**
- **Life cycle project management**
- **Increased efficiency, capacity and safety**
- **Risk analysis framework for investment decision support**

Regional Sediment Management Program

Improve sediment management practices through a system-based approach or manage projects in a regional context. The USACE has initiated efforts to manage sediment resources as a regional scale resource rather than a localized project resou

Dredging Operations Technical Support



PM: Dr. Doug Clarke

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Monitoring Completed Navigation Projects (MCNP)

Evaluate the performance of completed civil works navigation projects.

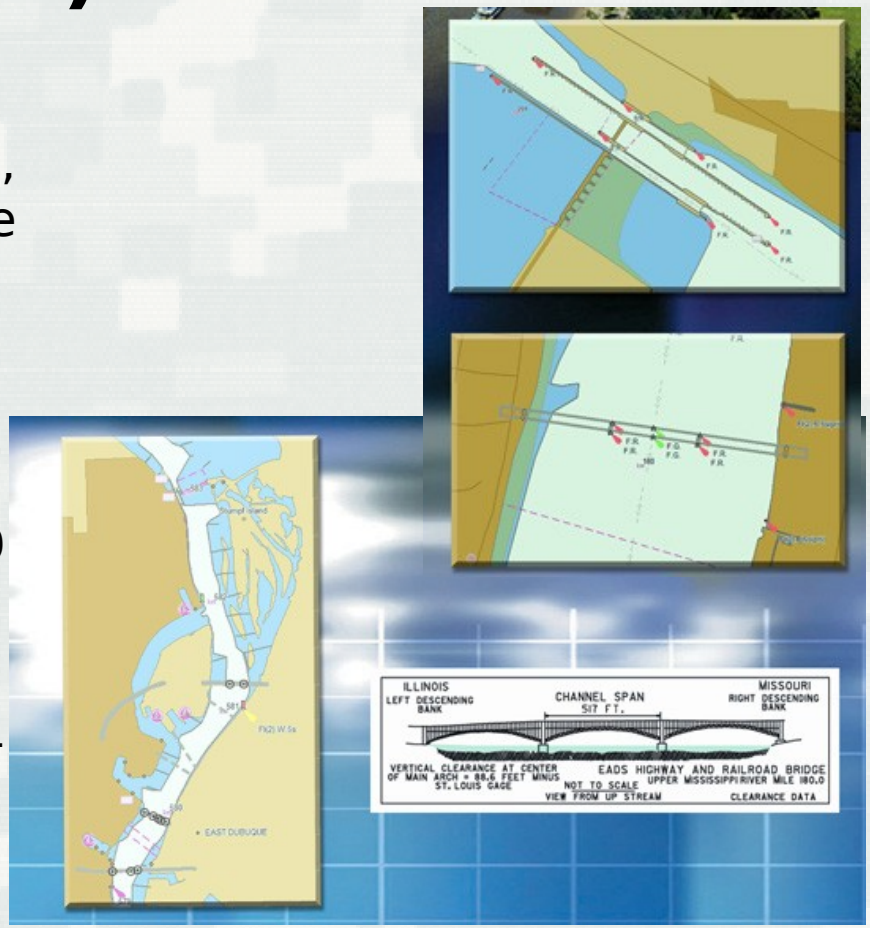
Create more accurate and economical engineering solutions

- **Strengthen design criteria and methodology**
- **Improve construction practices and cost effectiveness**
- **Improve operations and maintenance techniques**
- **Reduce O&M costs**

PM: Dr. Lyn Hales

Inland Electronic Navigational Charts (IENC)

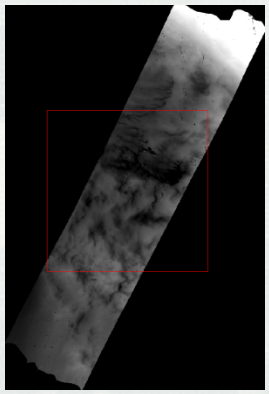
Increase safety and efficiency of inland navigation; provide accurate, reliable, and updated navigation charts for the Mississippi River and its tributaries (7,300 miles).


ILLINOIS
LEFT DESCENDING BANK
CHANNEL SPAN
517 FT.
MISSOURI
RIGHT DESCENDING BANK
VERTICAL CLEARANCE AT CENTER OF MAIN ARCH = 88.6 FEET MINUS ST. LOUIS GAGE
NOT TO SCALE
VIEW FROM UP STREAM
EADS HIGHWAY AND RAILROAD BRIDGE UPPER MISSISSIPPI RIVER MILE 180.0
CLEARANCE DATA

STATUS

- Ninety-three (93) IENCs, totaling 5,79 miles available as of January 2010.
- Five IENCs, totaling 499 miles scheduled for release by March 201
- Remaining 1005 miles scheduled for completion in FY10.

Coastal Zone Mapping and Imaging Lidar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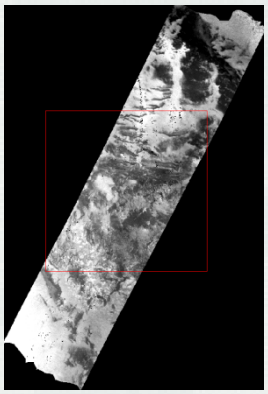
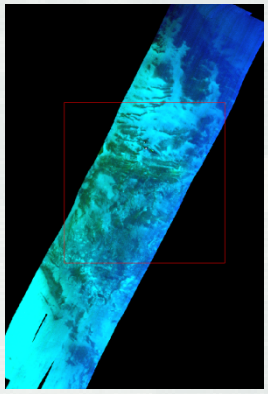
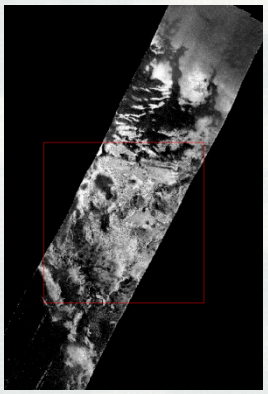
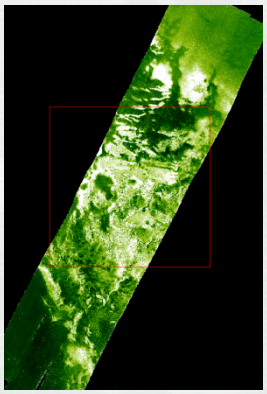
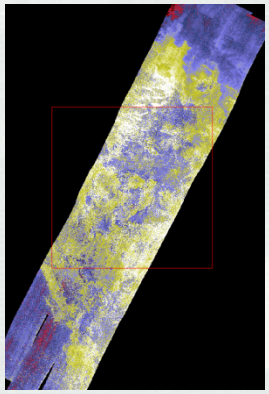
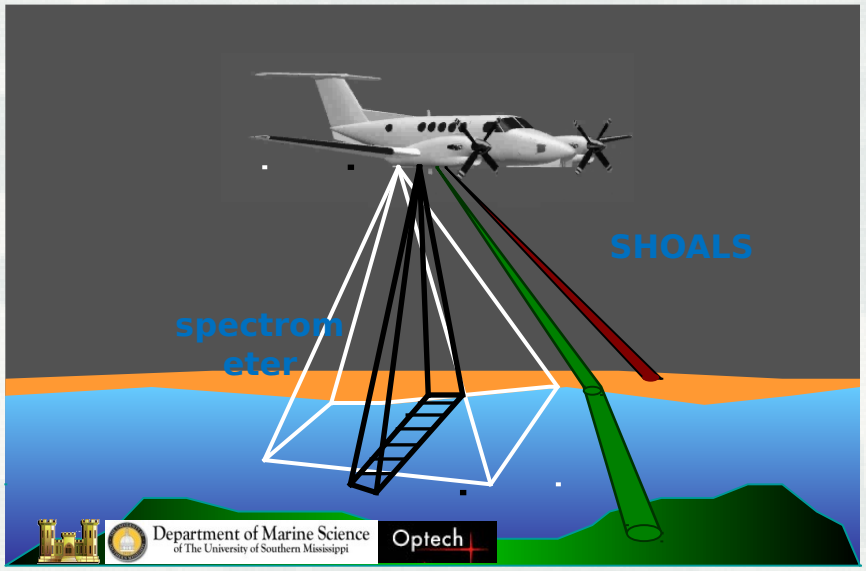

seafloor reflectance


RGB


attenuation


chlorophyll


CDOM



bottom classification

FY08/09 detailed design
FY09/10 fabrication
FY10/11 field test and depl
for National Coast
Mapping Program

PM: Jennifer Wozencraft

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R&D support to Nav Mission

- Asset Condition Assessments
- Non-Destructive Testing
- Extend Service Life
- Use material stored in CDF's
- Sustainable maintenance dredging practices

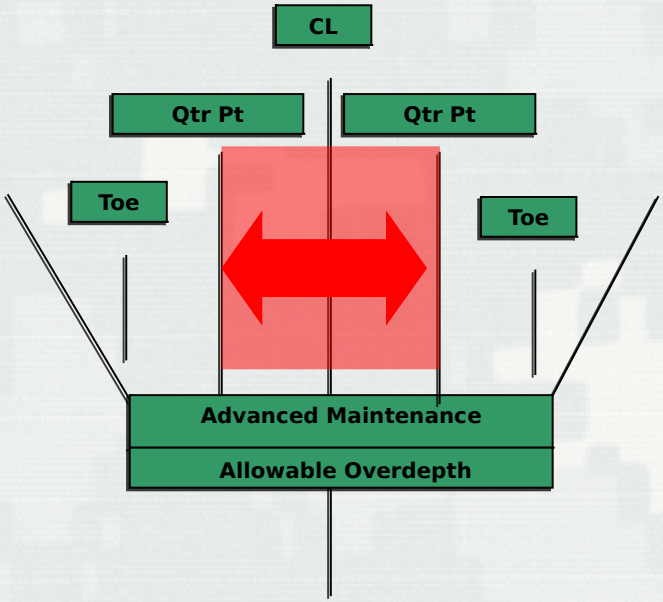

TABLE V-3
Relative Risk Ranking Matrix

Consequence Category	Condition / Condition Classification	F (Failed)	D (Inadequate)	C (Probably Inadequate)	B (Probably Adequate)	A (Adequate)
	I	25	24	22	19	15
	II	23	21	18	14	10
	III	20	17	13	9	6
	IV	16	12	8	5	3
	V	11	7	4	2	1

In 5 years…

- New Panama Canal open
- Bigger ships – deeper channels?
- Aging Infrastructure
- DMDF’s filling to capacity
- Beneficial Use of Dredged Material
- Climate Change interest/concern

In 10 years…

- Northwest Passage Open?
- Climate Change – more/less of an issue?
- Major leadership turnover in USACE and ERDC

Data Integration Framework

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Coastal Working Group Survey

26 Data Use Questions

Office Symbol	Division	District	1. What types of coastal projects do you have? (i.e. shoreline protection, beach nourishment, shallow draft harbors, deep draft harbors, recreation, environmental restoration, etc.)
LRC, LRB	Great Lakes and Ohio River Division	Buffalo, Chicago	shoreline protection, beach nourishment, shallow draft harbors, deep draft harbors, recreation, environmental restoration, confined disposal facilities, navigation channels dredging projects
LRE		Detroit	Shore protection, Re-hab of Navigation Structures (Shallow and Deep Draft, Sediment Transport Studies, Dredged Sediment Placement Studies, Inner Harbor Wave Analyses, FEMA Flood Elevation Determination, Lawsuit Defense Studies
NAE	North Atlantic Division	New England	Shoreline protection and inundation prevention, coastal structure repair, beach nourishment, shallow draft harbors, deep draft harbors, recreation, environmental restoration, confined disposal facilities, navigation channels dredging projects
NAN		New York	shoreline protection (storm damage reduction), beach nourishment, shallow draft harbors, deep draft harbors, ecosystem restoration, intrscoastal waterways, breakwaters, coastal inlets
NAP		Philadelphia	Hurricane and Storm Damage Reduction projects (including 10 beach nourishment projects), coastal structures (seawalls, jetties, revetments), shallow draft navigation, submerged breakwaters, environmental restoration
NAB		Baltimore	Shoreline Protection; Beach Nourishment; Shallow draft navigation, environmental restoration, Sand bypassing
NAO		Norfolk	Storm damage reduction, ecosystem restoration, beach renourishment, shallow and deep draft navigation projects
SAW	South Atlantic Division	Wilmington	Shoreline protection, beach nourishment, deep draft harbors, shallow draft channels, and environmental restoration.
SAW		Charleston	Shoreline protection, beach nourishment, deep draft harbors, shallow draft channels, and environmental restoration.
SAS		Savannah	Deep Draft Navigation Harbors, Beach Renourishment, Environmental Mitigation/Restoration, Dredged Material Disposal Areas, Shallow Draft Waterways, Flood Damage Reduction
SAJ -EN		Jacksonville	All of the above.
SAJ -PD		Jacksonville	all of the above; mainly shore protection with beach nourishment. hard structures used to a lesser extent. current construction of hard structures is to maintain beach fill in place. Navigation projects include both deep and shallow draft navigation and Intra Coastal Waterway. Navigation: deep draft harbors at 5 major cities and various shallow draft projects as well as the Gulf and Atlantic Intra Coastal Waterways
SAM		Mobile	Shoreline protection, beach nourishment, deep draft navigation harbor, restoration.
MVN	Mississippi Valley Division	New Orleans	Beneficial Use, Marsh restoration and protection, shoreline protection, Freshwater and sediment diversions, deep draft navigation channels, locks, gates, barrier island restoration, hydrologic restoration, sediment trapping, sand mining, sand management
SWG	Southwestern Division	Galveston	Coastal projects in SWG include coastal storm damage reduction, ecosystem restoration, deep-draft and shallow-draft navigation, and flood risk management. The coastal storm damage reduction project also takes into consideration a recreation aspect.
SPL	South Pacific Division	Los Angeles	All of the above including shoreline protection, storm damage reduction, navigation, recreation, ecosystem restoration.
SPN		San Francisco	Shore Protection, Flood Control, Shallow Draft Harbor, Deep Draft Harbors, Environmental Restoration
NWP	Northwestern Division	Portland	Deep draft and shallow draft navigation channels, rubblemound jetty navigation entrances, small boat harbors, riverine and estuary pile dike systems, shoreline erosion and protection, open water dredged material disposal sites, environmental restoration, shoreline/coastal flooding
NWS		Seattle	Shallow draft harbors, deep draft harbors, environmental restoration, beach nourishment
POA	Pacific Ocean Division	Alaska	shore protection, deep draft navigation, shallow draft harbor, flood damage reduction
POH		Hawaii	shoreline protection, beach nourishment, shallow draft harbors, deep draft harbors

2 Summary Spreadsheets Compiling Input from 21 Coastal Districts

Office Symbol	Division	District	Beach Profiles: Sources of Data	Beach Profiles: Problems Encountered	Beach Profiles: Related Data Needs
LRC, LRB	Great Lakes and Ohio River Division	Buffalo, Chicago	SHOALS in-house surveys contract	SHOALS - inconsistent coverage due to turbidity and breaking waves	
LRE		Detroit	Contractors. D&M	Inconsistent datum	Denser coverage around harbor
NAE	North Atlantic Division	New England	SHOALS/CHARTS in-house surveys contract	SHOALS/Charts - inconsistent coverage due to turbidity and breaking waves	
NAN		New York	In house (survey Branch) Contract Engineering Staff Local University	timeliness of data collection increasing costs difficulty in getting immediate post-storm profiles (for model calibration)	LIDAR vs. short profiles
NAP		Philadelphia	Contractor, in-house non-Federal sponsor (DE) University (Stockton)	environmental windows (not completing profiles) accuracy in surf zone	technologies that develop accuracy surveying the surf zone
NAB		Baltimore	A-E	Control issues on occasion	
NAO		Norfolk	Local sponsor, Local Universities		
SAW	South Atlantic Division	Wilmington	Annual monitoring 2 projects.		
SAW		Charleston	University State of South Carolina contractor	incorrect equipment setup	
SAS		Savannah	Construction Contractor Surveys In-House Survey Crews	Reliability due to potential conflict of interest Due to the large tidal range, it is difficult to get both hydrographic and topographic surveys during a reasonable time frame.	
SAJ -EN		Jacksonville	AE's, In-house	none	
SAJ -PD		Jacksonville			
SAM		Mobile	Lidar, In-house Bathymetric Survey, State databases	Inconsistent vertical datums. Issues with post processing.	
MVN	Mississippi Valley Division	New Orleans			
SWG	Southwestern Division	Galveston			
SPL	South Pacific Division	Los Angeles	hydrographic and nearshore surveys Old Corps and BEB records Old County records BEACON/SANDAG Organization of Local Gov't	datum conversions, accuracy not geo-referenced ambiguous alignment and zero location inconsistent datums (vertical) and local datums	Data to Produce Accurate Beach Profiles, long-term records that are geo-referenced need frequent enough capture seasonal and long-term trend Comparing historic beach profiles with current profiles and LIDAR
SPN		San Francisco	Survey Contractors NOAA Coast & Geodetic Survey USGS Surveys In-house staff	Datums Variability in survey techniques or assumptions Poor understanding of the true accuracy of various survey techniques	Datums; transect reference point Risk and Uncertainty Lidar capable software and computer power
NWP	Northwestern Division	Portland	in-house crew, contractor State governments, local agencies photogrammetric methods, lidar	some datum and control issues ground control setup expensive	more regional coverage needed after storms
NWS		Seattle	District WA Dept. Ecology	Data is unavailable without requesting	Post-storm monitoring surveys of erosional hotspots
POA	Pacific Ocean Division	Alaska	Contract surveyor	survey control. vertical datum changed relative to survey due glacial rebound/and or sea level rise	new monuments and tide gaging to update old monuments
POH		Hawaii	A/E Contracts	Cost is extremely high in remote locations. Datum issues.	In-house resources and tools would be beneficial.

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IOOS DIF Development Approach

Start Small

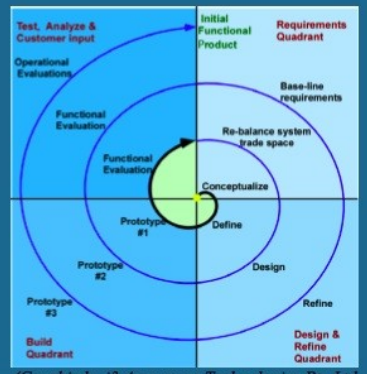
Be Specific

Don’t duplicate data

Maximize value / impact

Data Integration Framework (DIF)

- First spiral of IOOS development
- Standardize on small number of services & encodings
- Implement at selected provider & customer sites
- Start with several core variables
  - Currents
  - Temperature
  - Salinity
  - Water Level
  - Winds
  - Waves
  - Ocean Color (chlorophyll)
- Evaluate in FY 2010



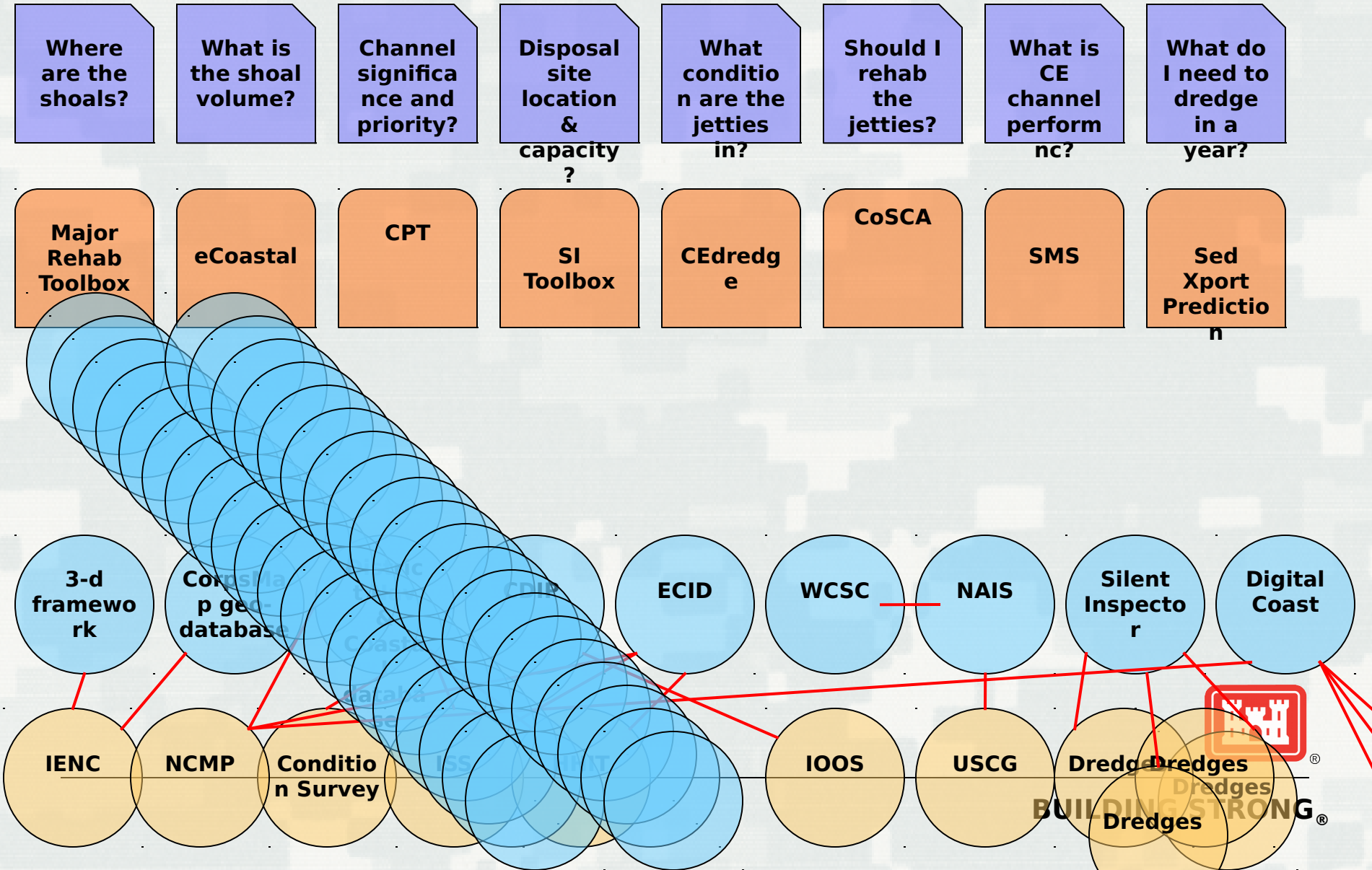
(Graphic by i3 Aerospace Technologies Pty Ltd – used with permission)

Mission Critical Decisions

- When to Dredge?
- Where to Dredge?
- Where to Place Material?
- Are there Alternatives to Dredging?
- What is the Dredge Availability?

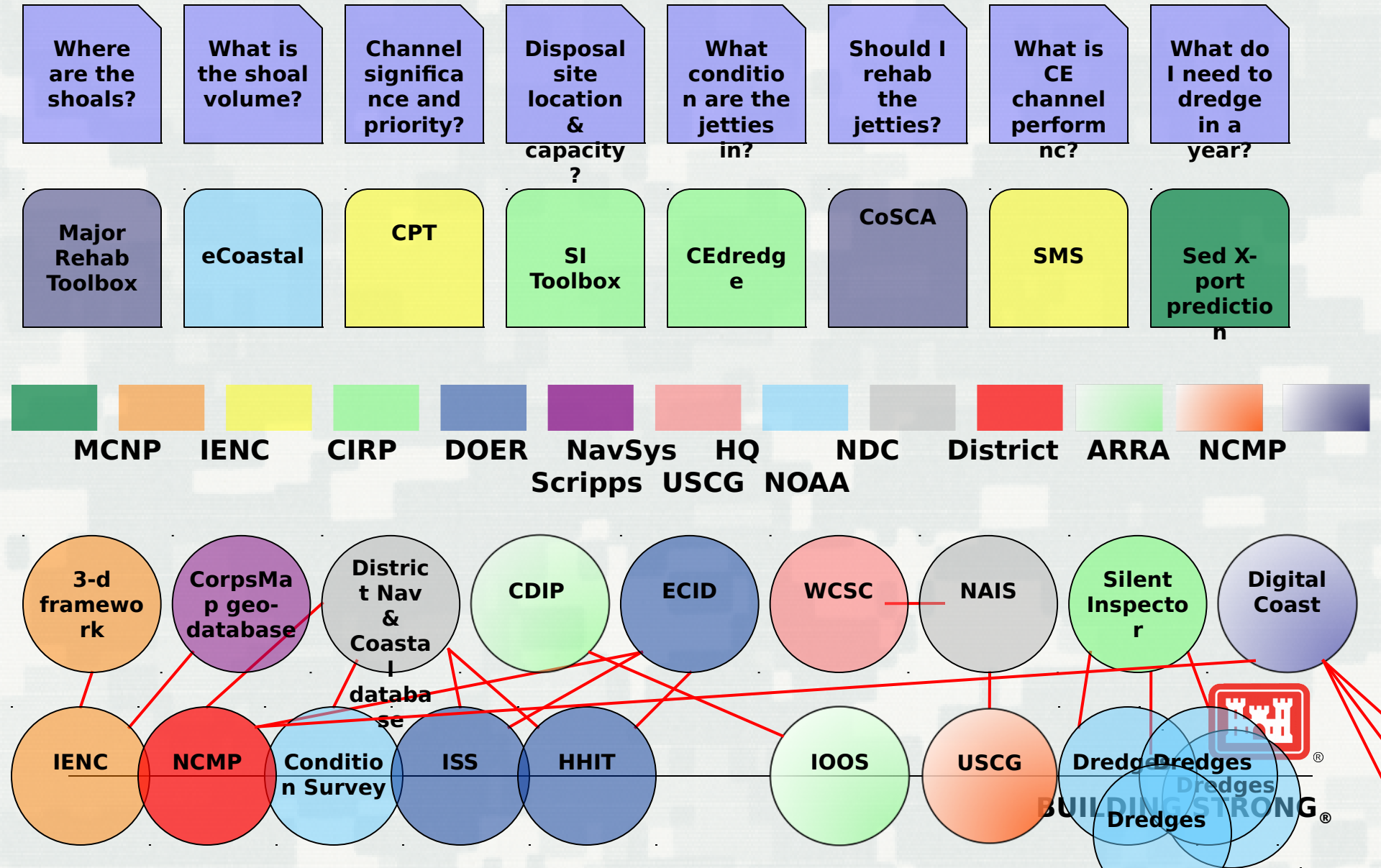
Integrated Coastal Navigation

Channels & Structures



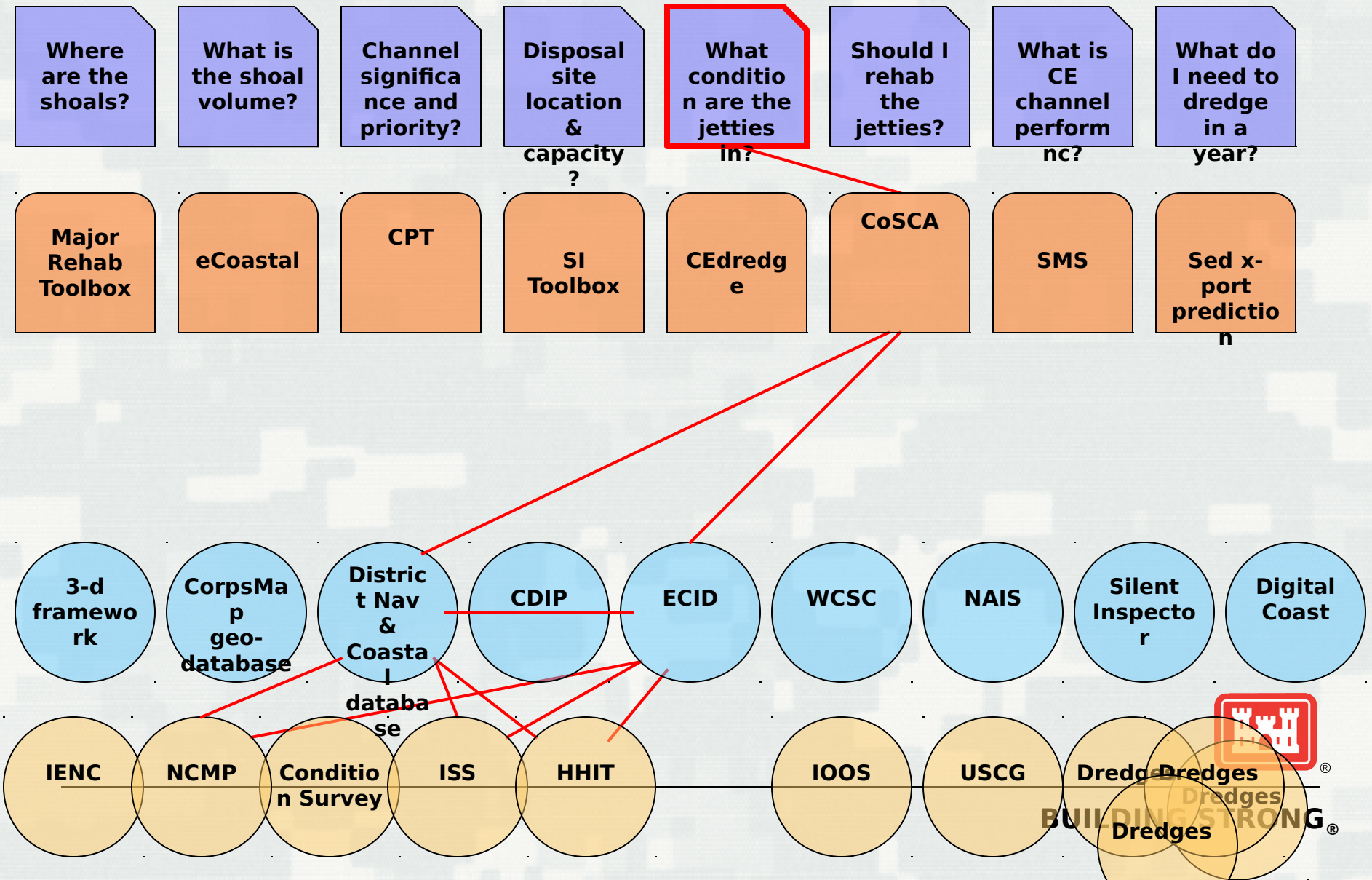
Integrated Coastal Navigation

Program Interaction

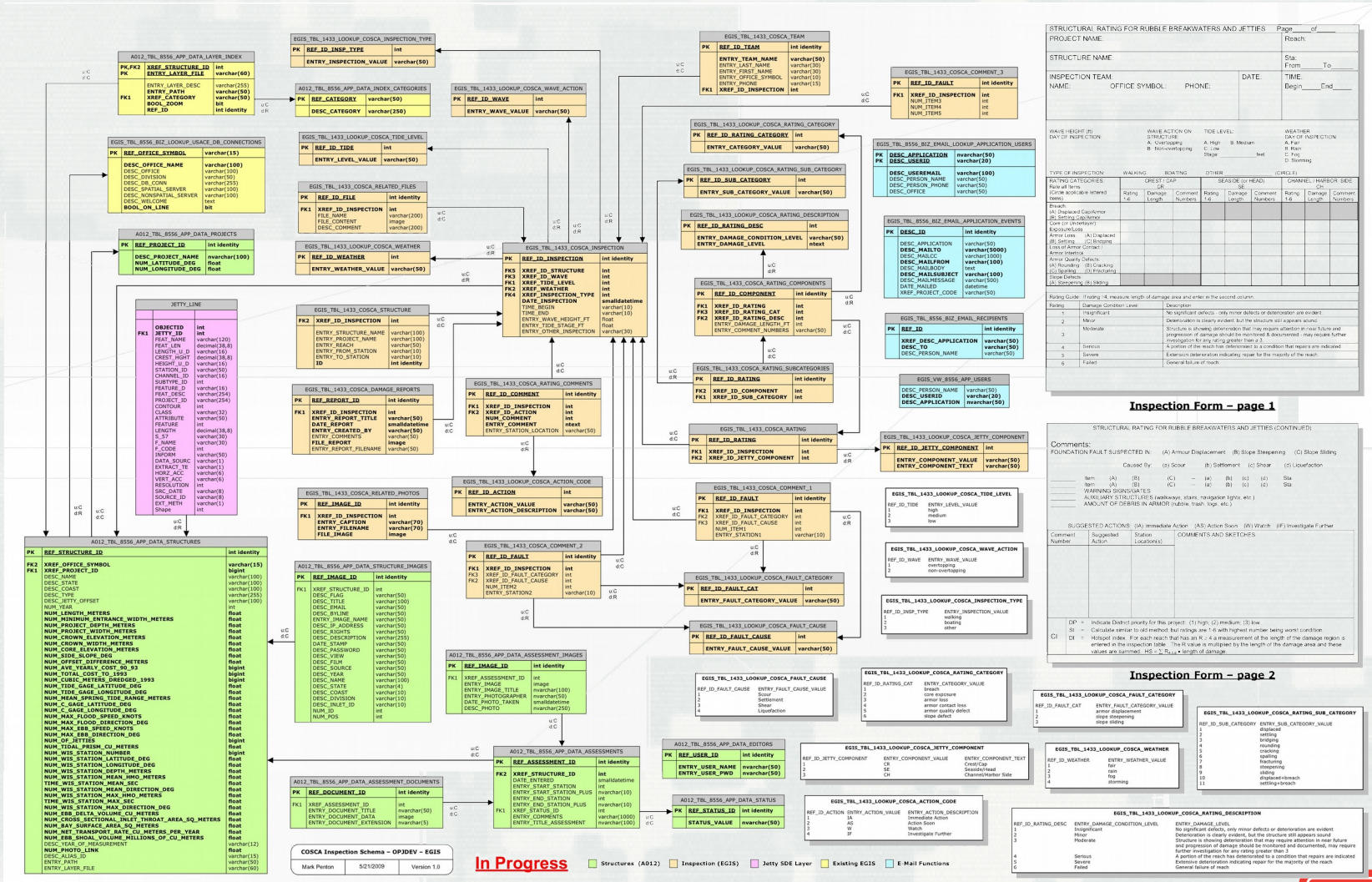


Integrated Coastal Navigation

Jetty Condition



CoSCA Framework



STRUCTURAL RATING FOR RUBBLE BREAKWATERS AND JETTIES
PROJECT NAME:
Reach:
STRUCTURE NAME:
INSPECTION TEAM:
NAME:
OFFICE SYMBOL:
PHONE:
DATE:
TIME:
Begin
End
TYPE OF INSPECTION:
WALKING
BOARDING
OTHER
(CIRCLE)
RATING CATEGORIES:
Refer all Items
(Circle applicable lettered items)
CREST / CAP OR SEASIDE (or HEAD)
CHANNEL / HARBOR SIDE OR
Rating 1-6
Damage Length
Comment Numbers
Breach
(A) Displaced Cap/Armor
(B) Settling Cap/Armor
Core (or Underlayer)
Exposed/Loss
Armor Loss (A) Displaced
(B) Settling (C) Missing
Loss of Armor Contact:
Armor Interlock
Armor Quality Defects:
(A) Rounding (B) Cracking
(C) Spalling (D) Fracturing
Slope Defects
(A) Steepening (B) Sliding
Rating Guide: If rating >4, measure length of damage area and enter in the second column.
Rating
Damage Condition Level
Description
1 Insignificant No significant defects - only minor defects or deterioration are evident
2 Minor Deterioration is clearly evident, but the structure still appears sound
3 Moderate Structure is showing deterioration that may require attention in near future and progression of damage should be monitored & documented - may require further investigation for any rating greater than a 3
4 Serious A portion of the reach has deteriorated to a condition that repairs are indicated
5 Severe Extension deterioration indicating repair for the majority of the reach
6 Failed General failure of reach
Inspection Form – page 1
STRUCTURAL RATING FOR RUBBLE BREAKWATERS AND JETTIES (CONTINUED)
Comments:
FOUNDATION FAULT SUSPECTED IN: (A) Armour Displacement (B) Slope Steepening (C) Slope Sliding
Caused By: (a) Scour (b) Settlement (c) Shear (d) Liquefaction
WARNING SIGNS/GATES
AUXILIARY STRUCTURES (walkways, stairs, navigation lights, etc.)
AMOUNT OF DEBRIS IN ARMOR (rubble, trash, logs, etc.)
SUGGESTED ACTIONS: (IA) Immediate Action (AS) Action Soon (W) Watch (IF) Investigate Further
Comment Number
Suggested Action
Station Location(s)
COMMENTS AND SKETCHES
DP = Indicate District priority for this project: (1) high, (2) medium, (3) low.
SI = Calculate similar to old method, but ratings are 1-6 with highest number being worst condition.
DI = Hotspot analysis. For each reach that has an R ≥ 4 a measurement of the length of the damage region is entered in the inspection table. The R value is multiplied by the length of the damage area and these values are summed. HS = Σ Rn,n • length of damage.
Inspection Form – page 2

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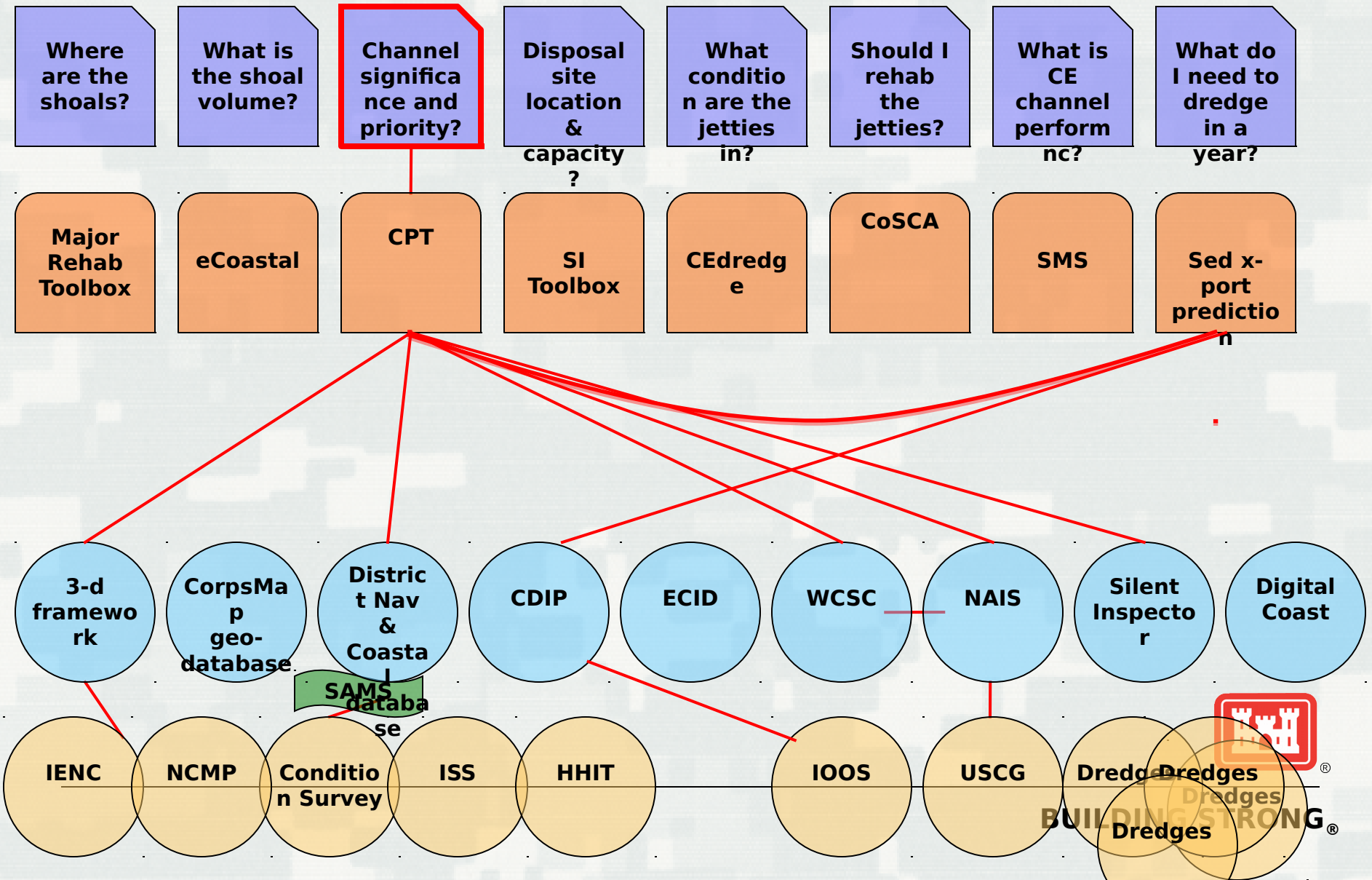
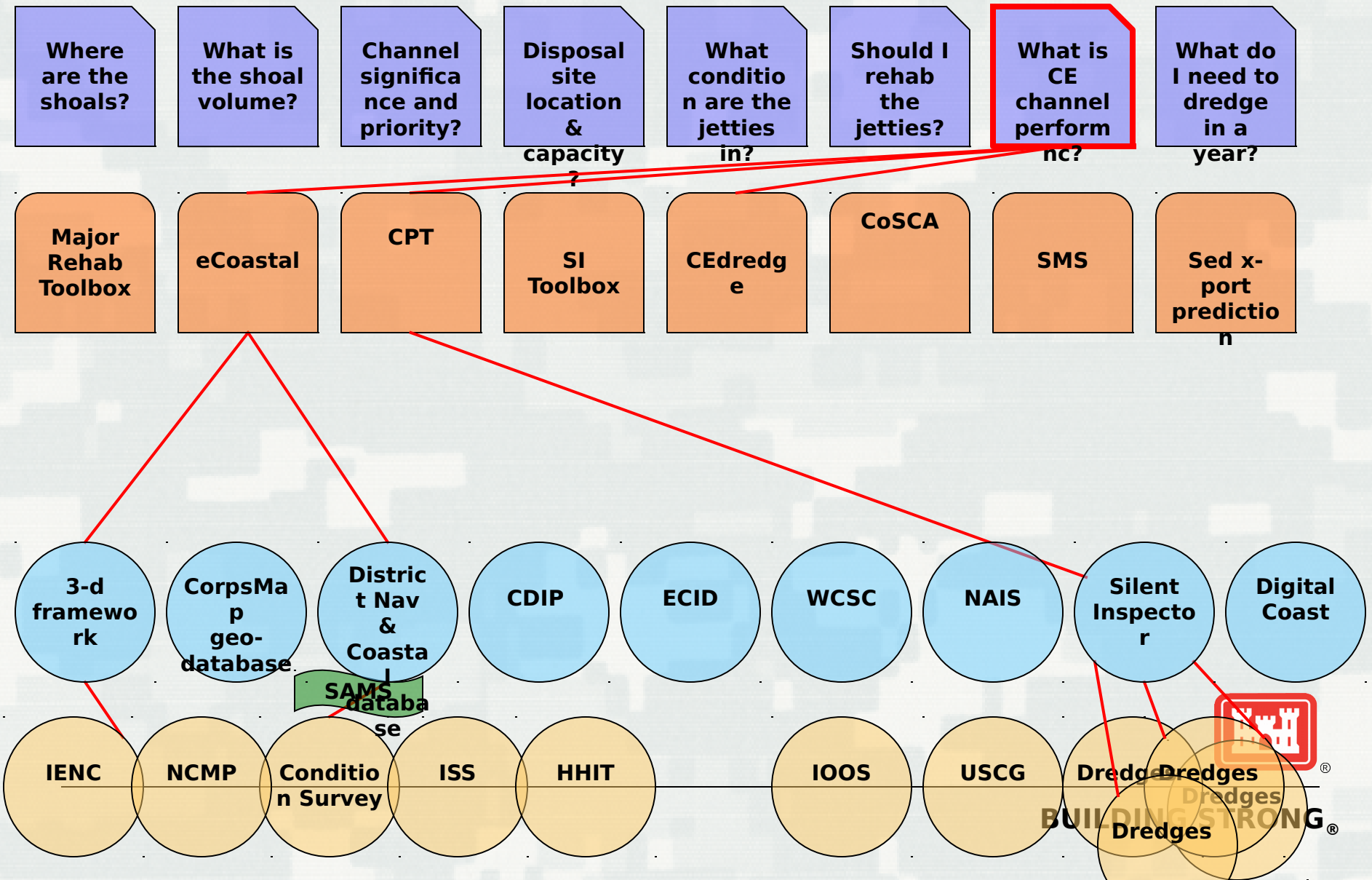
Integrated Coastal Navigation

Channel Priority



Integrated Coastal Navigation

Channel Performance Indices



Data Integration Framework

Thank You